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LATIN RHOTACISM: A CASE STUDY IN THE LIFE CYCLE OF PHONOLOGICAL
PROCESSES

By PHILIP J. ROBERTS

University of Oxford

Abstract

Rhotacism in Latin is a well-known phonological generalisation which, in its paradigm cases, can be stated as a regular sound change of [s] to [r] between vowels. This change/rule is posited on the basis both of comparative evidence, e.g. **swesor* > Latin *soror* ‘sister’, and of paradigms in which final *s* alternates with medial intervocalic *r*, e.g. *flos*, *floris* ‘flower’. It is possible, however, to cite a number of exceptions to the basic rule, which, if one attempts to account for all of them in a synchronic grammar, amount to outright paradoxes. This paper presents a diachronic model of the progress of rhotacism through the expected life-cycle of a phonological process, within the formalism of Stratal Optimality Theory, and demonstrates that this model can account for the exceptions to rhotacism as epiphenomena of the expected progress of the constraint ranking giving rise to it from phrase- to word-level, and from word- to stem-level. Finally, I argue that rhotacism became a systematic property of the lexicon, at which point it was subject to analogical extension, giving the paradigm levelling observed in e.g. *honor*, *honoris* ‘honour’ (formerly *honos*, *honoris*).

1. INTRODUCTION

1.1. The data

Rhotacism in Latin is a well-known phonological generalisation which, in its paradigm cases, can be stated in generative terms as ‘intervocalic /s/ is realised as [r]’, or, in the Neogrammarian tradition, as a regular sound change of *s* to *r* between vowels. This change/rule is posited on the basis both of comparative evidence, e.g. **swesōr* > Latin *soror* ‘sister’, and of paradigms in which final *s* alternates with medial intervocalic *r*, e.g. *flōs*, *flōris* ‘flower’. It is possible, however, to cite a number of exceptions to the basic rule:

- (1) a. Geminate *ss* is regularly exempt from rhotacism, examples include *gessi* ‘I undertook’, *missum* ‘sent’. Following a long vowel or diphthong the *ss* regularly degeminated to *s*, which created a class of apparent exceptions to rhotacism, e.g. *suāsum* ‘persuaded’, *vīsus* ‘seen’, *causa* ‘cause’ (Leumann 1977: §182).
- b. Certain identifiable loanwords show intervocalic ⟨s⟩, such as *basis* ‘pedestal’ (from Greek), *cisium* ‘cabriolet’ (from Gaulish), *mense Flusare* ‘in the month of Floréal’ (from Oscan). The earliest attestations of these loans are generally late, so it has been argued that they were borrowed after rhotacism ceased to be an active part of the phonology (Leumann 1977: §180, q.v. for all remaining exceptions).
- c. In words that are transparently morphologically complex exceptions to rhotacism are regularly found at morpheme boundaries: *dē-siliō* ‘I jump down’ (cf. *saliō* ‘I jump’), *nī-sī* ‘unless’ (cf. *sī* ‘if’).
- d. Rhotacism appears to be blocked when the *s* co-occurs with an *r* in an adjacent syllable: for example, in *miser* ‘wretched’ (for which we might expect **merer*, cf. the verb *maereō*, *maestus* ‘lament’), and in *caesariēs* ‘luxuriant hair’ (cf. Sanskrit *kēsara-* ‘mane’). However, there are apparent counterexamples where one *r* is the product of rhotacism, including *soror* ‘sister’ < **swesōr* (cf. German *Schwester*), *uror* ‘I am burnt’ (cf. the supine *ustum*).
- e. Finally, there is the much discussed apparent overapplication of rhotacism in nouns of the type *honor*, *honōris* ‘honour’ (formerly *honōs*, *honōris*). In the comparative

tradition this is treated as a case of paradigm levelling and four-part analogy combined, given the extant pattern of nouns declining in *-or*, *-oris* (like *soror* ‘sister’, *uxor* ‘wife’ and agent nouns in *-tor*). Eventually the spread of *r* comes to affect all polysyllabic nouns of the appropriate type, so that we find e.g. *honor*, *arbor* ‘tree’, *labor* ‘work’, in place of earlier *honos*, *arbos*, *labos*. Monosyllables, however, are not affected, so we have e.g. only *mōs*, *mōris* ‘custom’.

If one attempts to model rhotacism as a synchronic process in Classical Latin, the over- and under-generations listed in (1) amount, in some cases, to outright paradoxes. For example, the dissimilatory blocking of rhotacism in *miser* and *caesariēs* is absent from forms like *soror* and *uror*. Then again, the qualifier ‘transparently’ is present in (1c) with good reason: we have on the one hand forms where rhotacism appears to be sensitive to morpheme boundaries, and on the other forms where it is apparently not, such as *dir-imō* ‘I take apart’ and *dir-(h)ibeō* ‘I lay apart’ (Baldi 1994: 209–10). For a counterexample with the same *dis-* prefix, see *disertus* ‘discussed’, which is discussed by Leumann (1969, 1977: 179).

The notion that a diachronic awareness is necessary to produce a complete descriptive account of rhotacism is not a new one: Touratier (1975) proposes an account in which there are two synchronic stages. In the first, rhotacism is a purely phonological process, then in the second the rule becomes sensitive to morphological structure. Baldi (1994) notes that rhotacism did not begin to affect what were historically geminates after they simplified to *s*: we do not have e.g. *caura* for *causa* (formerly *caussa*), and concludes that rhotacism in Classical Latin is the lexical residue of a phonological rule that is no longer active. The same position is more or less a prerequisite of the arguments of e.g. Kiparsky (1982a) and Albright (2005), who argue, in generative terms, for the extension of *r* to the nominative in nouns of the *honōs*, *honōris* type as analogical input restructuring.

The purpose of this paper is to argue that, in effect, all these accounts are correct, for different stages of the language, and that they should be expected to be correct, given what has been observed about the life cycle of phonological generalisations. Finally, I present a unified model of the history of rhotacism in Latin, within a theoretical framework that incorporates the life cycle in its architecture, namely Stratal Optimality Theory (OT).

1.2. *The life cycle*

Wherever records allow us to observe multiple generations' implementations of a phonological process, it has been observed repeatedly since Baudouin de Courtenay (1895) that the domain of the generalisation tends to shrink over time. Rules that begin by obeying the Neogrammarian prescription and being exceptionless become increasingly sensitive to the morpho-syntactic structure of their environment, typically by ceasing to apply when a boundary intervenes in the relevant context. Finally, when the morpho-syntactic conditioning obscures the phonological conditioning sufficiently, the rule can become systematised as a set of lexical exceptions. In formalisms such as Lexical Phonology and Stratal OT, this is modelled in terms of a rule or constraint ranking ascending from the phrase- to the word-level, then from the word- to the stem-level.

Bermúdez-Otero (1999, 2007, 2011) provides a classification of the life cycle into discrete stages, as follows:-

- (2) STAGE 0 — GRADIENT PHONETIC RULES. Co-articulatory pressures create a tendency towards a different realisation of a segment in a particular phonetic environment.

STAGE 1 — CATEGORICAL POSTLEXICAL RULES. The phonetic tendency is stabilised into a categorical rule, involving modification of a feature or other item in the output representation. The rule continues to apply in its specified environment irrespective of word or morpheme boundaries.

STAGE 2 — WORD-LEVEL RULES. The rule ceases to apply across word boundaries. Within words, the rule is enforced productively, i.e. paradigmatic alternants that create the rule's environment will cause the rule to apply.

STAGE 3 — STEM-LEVEL RULES. The rule is sensitive to morpheme boundaries, and applies only if its entire environment falls within the stem-level domain.

STAGE L — LEXICAL LISTING. The environment of the rule is opaque due to boundary conditions. The rule has become a systematic set of lexical exceptions, and is no longer productive. If its domain does spread, it does so by analogical diffusion through the lexicon, not necessarily respecting the original environment

of the phonological rule.

(Adapted from Bermúdez-Otero 2011: §3)

1.3. Stratal Optimality Theory

Stratal Optimality Theory (Stratal OT: Kiparsky 2000b) retains the basic theoretical architecture proposed by Prince & Smolensky (1993): the phonology maps an input onto an output by evaluating an exhaustive candidate set against a transitively ranked hierarchy of constraints, and selecting as output the candidate whose violations are least expensive. Where Stratal OT and Classic OT differ is in their approach to opacity and the morphology-phonology interface.

Stratal OT accounts for the fact that some phonological processes are sensitive to boundaries by re-introducing a very limited degree of serialism into the generation of outputs. The derivation of an output from an input, in Stratal OT, involves three, and only three, Optimality-Theoretic co-phonologies: the stem-level, the word-level and the phrase-level. If a given input contains a stem-level domain (which is defined idiosyncratically from language to language), the material in the stem-level domain is passed as input to the stem-level co-phonology; the material in the prosodic word is then concatenated with the output from the stem-level, and passed through the word-level co-phonology, and finally the outputs from the word-level co-phonology for each prosodic word are concatenated together and passed as input to the phrase-level co-phonology, which produces the whole utterance as its output.

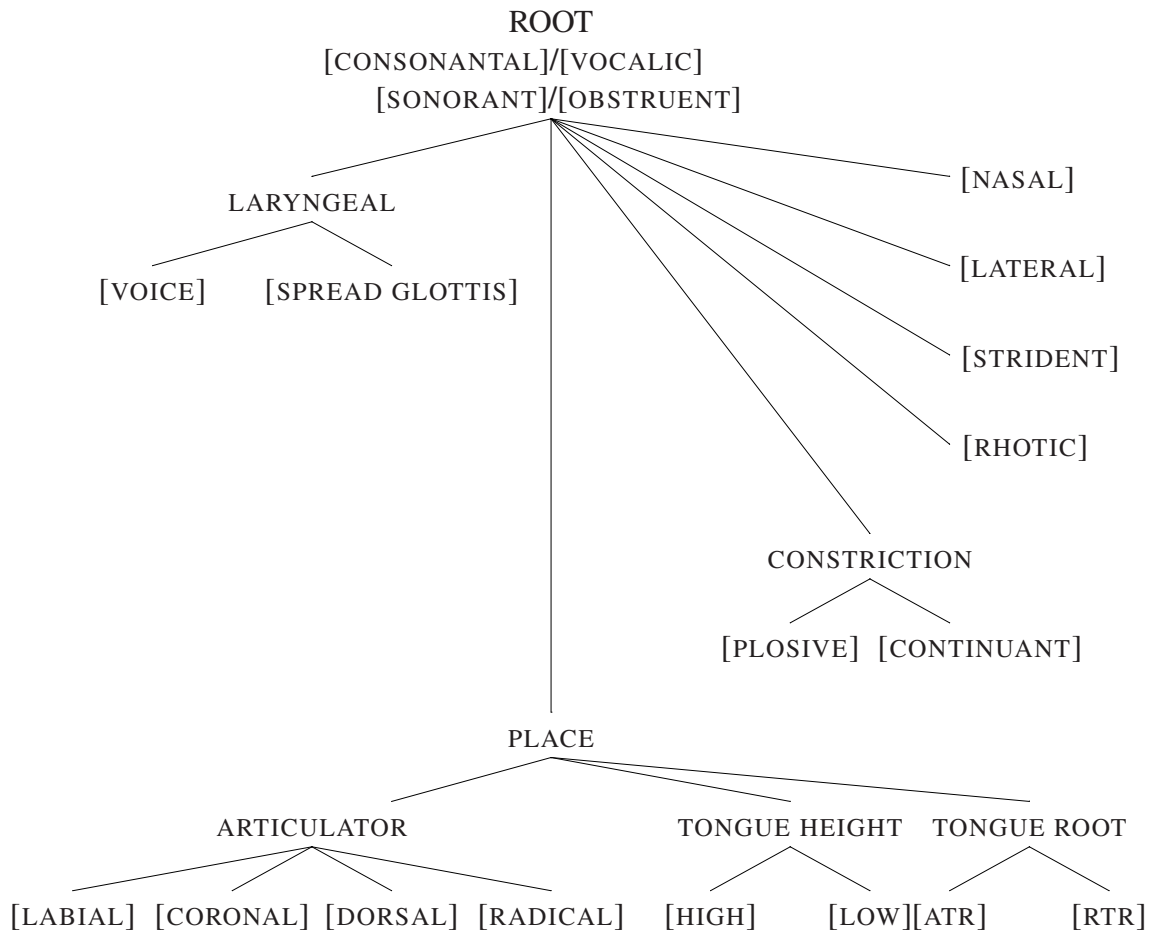
Like its predecessor, Lexical Phonology (Kiparsky 1982b,c), Stratal OT incorporates the life cycle of phonological generalisations into its basic architecture: as analogy causes the domain of a phonological process to shrink, generations of learners acquire constraint rankings at progressively higher strata of the grammar (Bermúdez-Otero 2003).

1.4. Further theoretical issues

The decision to use an Optimality-Theoretic model of phonology neither precludes nor requires any particular theory of phonological representations. In particular, OT itself makes no claims as to which set of distinctive features should be employed. I use the features from

the Featurally Underspecified Lexicon (FUL) model, which are organised as follows:

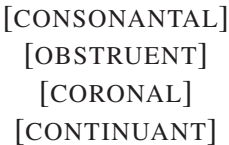
(3) Feature geometry in FUL:



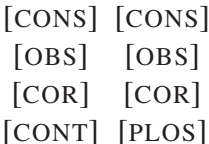
(Lahiri & Reetz 2010: 46)

I also appeal to the theory of representations to explain why geminates were exempt from rhotacism: I argue that geminate *ss* did not undergo rhotacism because geminates in Latin are representationally equivalent to consonant clusters (cf. the arguments for geminate clusters in Kenstowicz & Pyle 1973, and the account of inalterability in Hayes 1986); that is to say they have the following structure:

(4) Phonological representation of the sequence ... *assa* ...:



(5) Phonological representation of the sequence ...*asta*...:



This claim is supported by the fact that in verse scansion, a syllable followed by a geminate is long by position just as a syllable preceding a consonant cluster is, as in the following line of Vergil (Aeneid 1.16):

(6) *pōsthābī|tā* *cōlū|īssē* *Sā|mō ||* *hīc |* *īllūs |*
neglected-ABL.SG cherish-PRF.INF Samos-ABL.SG here DIST.GEN.SG
ārmā
weapons-NOM.PL

This merely re-states in formal terms the standard, pre-theoretical account of why rhotacism did not affect *ss*: that it represents, in some sense, two instances of [s], as the

writing system suggests, so that neither is intervocalic and therefore neither is subject to rhotacism.

Under these independently justified theoretical assumptions, we can construct an internally consistent model of the historical progression of rhotacism as a phonological generalisation, in Optimality-Theoretic terms.

2. THE LIFE CYCLE OF RHOTACISM

If we construct an account of the development of rhotacism that assumes a standard progression through the stages of the life cycle, we arrive at an analysis which predicts the exceptions in (1) and has the potential to resolve the paradoxes arising from them.

2.1. Stage 0 — a phonetic tendency

The Stage 0 for rhotacism has effectively already been proposed: it is uncontroversially assumed that rhotacism in Latin began with a tendency for intervocalic /s/ to be realised with voicing, i.e. as [z] (Leumann 1977: §180; Allen 1978: 35; Meiser 1998: 95). This kind of phonetic tendency—for the inherent vocal-fold vibration of segments to bleed into their neighbours, has been observed in a number of phonetic studies (Lisker 1957; Keating 1980; Westbury & Keating 1986). It has also been observed that this tendency can be codified into the phonology in a number of different ways: in the *distinción* dialects of Peninsular Spanish, for example, /θ/ is realised as [ð] when it precedes a sonorant (Hammond 2001: 231); in Old English, fricatives were realised as voiced between vowels and when adjacent to sonorants (Lass 1971); for more examples, see Cho (1990). I propose that in the phrase-level phonology of Latin, the tendency to voicing was systematised such that /s/ acquired the [VOICE] feature iff it was intervocalic.

2.2. Stage 1 — phrase-level phonology

Phonetic tendencies at stage 0 are gradient, they apply to different degrees to different segments and in different contexts. Since the voicing process that presaged rhotacism seems only to have affected /s/, I argue that it was formalised in the phrase-level phonology as the

result of a constraint ranking that assigns the feature [VOICE] to those obstruents that do not have contrastively voiced counterparts, whenever they occur between vowels. I make this claim because it allows rhotacism to be seen as part of a wider cross-linguistic pattern of non-neutralising intervocalic obstruent voicing (IOV).

Examples of IOV can be found in many languages, including Korean, Mohawk, Italian and Old English (Major & Faudree 1996; Lakoff 1993; Dinnsen & Eckman 1978). What these examples have in common is that they affect all and only those voiceless obstruents which lack a contrastively voiced homorganic counterpart. Old English, for example, contrasts stops for voicing—observe, for example, the minimal pair [bæθ] ‘bath’ and [pæθ] ‘path’—but has only one series of fricatives, whose possession or otherwise of the [VOICE] feature is entirely predictable from their position: compare [smiθ] ‘smith’ with [smiðas] ‘smiths’ (examples from Dinnsen & Eckman 1978: 6). Korean, by contrast, has no contrastively voiced obstruents at all, and all its voiceless obstruents are subject to IOV (Major & Faudree 1996).

Latin fits quite neatly into this same framework: it displays a contrast of voiced vs. voiceless stops, but does not have a contrastively voiced series of fricatives. Its voiceless fricatives, /s/ and /f/, are arguably both subject to IOV. Intervocalic /s/ is realised as [z] and then partially merges with /r/, while, in the native vocabulary, /f/ is simply not found between vowels. Forms with intervocalic [f], such as the name *Rufus*, are generally loans from Sabellian.

It is worth noting that IOV is a standard component of accounts of the positionally disparate reflexes of the Indo-European voiced aspirates, which are *f* initially and voiced stops elsewhere. The various accounts, such as Ascoli (1868), Rix (1957) and Stuart-Smith (2004), all involve a change from plosives to fricatives with the classic, IOV-motivated distribution of voicing. Indeed, Stuart-Smith (2004: 91) assumes that the voicing of /s/ to [z] that gave rise to rhotacism was part of the same process. If we follow Stuart-Smith in this assumption, the parallel with Verner’s Law in Germanic seems irresistible: by Verner’s Law, the Common Germanic fricatives, which were the reflexes of the voiceless stops of Indo-European, plus inherited /s/, became voiced word-medially in a specific, stress-dependent environment (Ringe 2006: 102–5).

The sequel to Verner’s Law is particularly instructive in comparison: the voiced fricatives merged with voiced stops (in favour of a fricative realisation, as opposed to the plosives of Latin), with the exception of [z], **which became [r] in the Verner’s Law environment** in North and West Germanic (cf. OE *cēosan* ‘to choose’ and *coren* ‘chosen’ (Campbell 1959: §404))

In sum, the reflexes of the PIE sounds in the relevant environments are as follows:

(7)	PIE	*b ^h	*d ^h	*s	*g ^h	*g ^{wh}		*p	*t	*s	*k	*k ^w
	PItal.	*β	*ð	*z	*ɣ	*ɣ ^w	PGmc.	*β	*ð	*z	*ɣ	*ɣ ^w
	Latin	b	d (b)	r	h	w	OE	v	ð	r	g	g (w)

It should be noted that this table lists only intervocalic reflexes in Latin, and only reflexes in the Verner’s Law environment in Germanic, and the effects of other sound changes have been compensated for; for full details see the relevant sections of Stuart-Smith (2004) and Ringe (2006), as cited above.

We can bring rhotacism into the fold of IOV by means of the observation that it is necessary to decouple targets from repair strategies. According to this doctrine, which is architecturally implicit in OT, realising input /s/ as [z] or [r] between vowels is equally effective at eliminating the marked structure—an intervocalic voiceless obstruent—from the output. Since non-neutralising IOV is such a cross-linguistically well-attested phonological pattern, sheer parsimony ought to encourage us to attempt to model both it and rhotacism by means of the same markedness constraints, with different rankings of faithfulness constraints determining the different repair strategies. Furthermore, as IOV itself is reconstructed for early Latin, couching our analysis of rhotacism in terms of the same markedness constraints that drive IOV will allow us to construct a model where the change from one historical grammar to the other is a quantum leap: the ranking of markedness constraints will remain the same, but the ranking of faithfulness constraints will change.

Kager (1999) proposes the following markedness constraint to penalise the target of IOV:

(8) INTER-V-VOICE

Assess a violation for every obstruent in the output that occurs between two vowels and has no [VOICE] feature.

Ranking this constraint above IDENT-[VOICE] will cause all intervocalic voiceless obstruents to be realised as voiced. In order to predict the pattern we find attested, where only those obstruents without contrastively voiced counterparts undergo IOV, and given that this non-neutralising pattern of IOV is so well attested across languages, I contend that we are justified in encoding it directly into the constraint set. Łubowicz (2003) makes the same argument for different phenomena, and proposes the following constraint schema:

(9) PRESERVECONTRAST(P) (abbreviated PC(P))

For each pair of inputs contrasting in P that map onto the same output in a scenario, assign a violation mark. Formally, assign one mark for every pair of inputs, in_a and in_b , if in_a has P and in_b lacks P, $in_a \rightarrow out_k$, and $in_b \rightarrow out_k$.

‘If inputs are distinct in P, they need to remain distinct.’

P is defined as referring to ‘a potentially contrastive phonological property, such as a distinctive feature’ (Łubowicz 2003: 18).


We can predict the required phrase-level pattern, voicing of only those segments without voiced counterparts (so, for Latin, only of /s/), using the following ranking.

(10) FAITH, PRESERVECONTRAST-[VOICE], INTER-V-VOICE \gg IDENT-[VOICE]


(Note that FAITH is used as a cover term for every faithfulness constraint not included elsewhere in the ranking.)

Thus /s/ surfaces as [z]:


(11)

ru:sis	FAITH	PC-[VOI]	INTER-V-VOICE	IDENT-[VOI]
a. ru:sis			*!	
 b. ru:zis				*
c. ru:dis	*!			*
d. ru:ris	*!			

But /t/ is hindered from surfacing as [d] by the contrastive distribution of /d/ in the system.

	rutis rudis	FAITH	PC-[VOI]	INTER-V-VOICE	IDENT-[VOI]
	a. rudis rudis		*!		*
(12)	 b. rutis rudis			*	
	c. rutis rutis	*!	*	**	
	d. rudis rutis			*	*!*
	e. ruzis rudis	*!			*

Note that the intervocalic [z] and [s] elsewhere are in complementary distribution, therefore, at this stage, we are dealing solely with allophony: in the native Latin phoneme inventory, there is one sibilant /s/, which is realised as [s] or [z] depending on environment. If we wish to follow Stuart-Smith (2004) and assume that the same allophonic distribution began to apply to the fricatives reflecting PIE voiced aspirates, the proposed constraint ranking allows this:

	neϕula	FAITH	PC-[VOI]	INTER-V-VOICE	IDENT-[VOI]
(13)	a. neϕula			*!	
	 b. neβula ¹				*

As regards the transition from stage 1 to stage 2, Catford (2001: 179) notes that ‘[i]t is generally assumed that the fact that intervocalic -z- (< -s-) came to be reinterpreted as an r implies that the /r/ of the language at that time must have been a fricative or approximant ɹ, or at least that such an r must have been an acceptable pronunciation of /r/.’ I follow this reasoning, which is more or less implicit in accounts of rhotacism of [s] via [z]. The [z] token of intervocalic /s/ must have been phonetically similar enough to at least one allophone of /r/ for a generation of learners to draw the conclusion that [ɹ] could reflect underlying /s/.

2.2.1. Stage 2 — word-level phonology

The parallel between stage 1 non-neutralising IOV and Verner’s Law is eminently arguable, but the parallel between the Latin merger of the fricatives with the stops and sonorants on the one hand, and the sequel to Verner’s Law on the other, is much less robust. The behaviour of the non-sibilant fricatives is distinctly different: they merge with the voiced stops because the

¹This form is attested as *nebula* ‘mist’.

allophones of the voiced stops in the relevant environment were voiced fricatives, and indeed often remain so in the Germanic daughter languages (see e.g. English *over* < PIE **upér(i)* (Ringe 2006: 102)). In Latin, by contrast, they merge with the plosives proper. This leaves only rhotacism, to which, depending on the particular quality of the /r/, almost any coronal consonant can be liable (see Catford 2001).

Based on the fact that the orthography of Latin does not show rhotacism applying across word boundaries, I claim that there was a change of repair strategy coincident with or later than the climb from the phrase level to the word level (had it been earlier, we might expect to find rhotacism attested at word boundaries, e.g. **rur in urbe* for *rus in urbe* vel sim.). IVV retained its relative ranking, penalising [s] between output vowels, but IDENT-[VOICE] was no longer the lowest-ranked faithfulness constraint. Instead, the constraints IDENT-[OBSTRUENT] and IDENT-[SONORANT] were ranked below IDENT-[VOICE] so that the outcome where /s/ is realised as [r] is optimal:

(14)

ru:sis	PC-[VOI]	IVV	IDENT-[VOI]	IDENT-[OBS]	IDENT-[SON]
a. ru:sis		*!			
b. ru:zis			*!		
☞ c. ru:ris				*	*

The dissimilatory blocking of rhotacism in e.g. *miser* and *caesariēs* occurs in deference to a markedness constraint that applies across the entire vocabulary of Latin. Cser (2010: 42–3) points out that a sequence rŕr is only found to occur in final syllables, and that all instances of final rŕr reflect an earlier rŕr, being the products of the shortening of vowels in closed word-final syllables that occurred circa 200 B.C.E. (Meiser 1998: 77). I claim in §2.4 below that at the time when the final shortening occurred, rhotacism had already entered Stage L of the life cycle, therefore I argue that at the period in the history of the language when rhotacism was a word-level process, the prohibition of rŕr was exceptionless, and also a part of the word-level phonology.

This co-occurrence restriction is by no means typologically surprising: compare the case of Yimas discussed by Suzuki (1998: 84–7), the English word *pilgrim* from Late Latin *pelegrinus* < *peregrinus*, and the dissimilation in colloquial Spanish, whereby canonical

glándula is realised as *grándula* (Lloret 1997: 125). I therefore adopt a constraint formulated according to Suzuki’s Generalised OCP schema to model it:

- (15) *[RHOTIC]- μ -[RHOTIC]: Assess a violation for every sequence of two segments with the feature [RHOTIC] separated by material amounting to one mora.

If we insert this constraint into our ranking so that it dominates INTER-V-VOICE, the grammar generates *miser* and *caesaries* correctly:

(16)

miser	FAITH	*[RHO]- μ -[RHO]	IVV	IDENT-[OBS]	IDENT-[SON]
a. mirer		*!		*	*
☞ b. miser			*		
c. mizer	*!				

(17)

caesarie:s	FAITH	*[RHO]- μ -[RHO]	IVV	IDENT-[OBS]	IDENT-[SON]
a. caerarie:s		*!		*	*
☞ b. caesarie:s			*		
c. caezarie:s	*!				

This ranking also predicts that an input /rosa/ will generate the attested *rōsa* ‘rose’.

Given this analysis of dissimilatory blocking, we might also expect to find e.g. **sosōr* instead of *sorōr*. However, *sorōr* reflects IE **swesōr*, with the short *o* of the attested form being the product of the second-century final shortening, therefore the input for it during the word-level stage of rhotacism would have been either /sweso:r/ or /soso:r/, depending on the relative chronology of the change of *we* to *o* (Meiser 1998: 82), and no violation of *[RHOTIC]- μ -[RHOTIC] is provoked.

2.3. Stage 3 — stem-level phonology

In this stage, morphological boundaries that obscure the environment of rhotacism keep it from applying, so we have *s* in *nī-sī* and *de-siliō*. This presupposes an analysis in which the prefix does not form part of the stem-level domain: the UR of, for example, *de-siliō* would be /_{[ω}de_{[stem}sali]o:/². This accords with the hypothesis in Roberts (2009: ch. 2) that, for regular

²This assumes that vowel weakening occurs on the word level.

forms, the phonological stem in Latin excludes the prefix, but otherwise includes all material up to, but not including the inflectional ending. Therefore, the input to the stem-level co-phonology is /sali/, in which the /s/ is not between vowels, therefore no violation of INTER-V-VOICE is provoked.

Given that endings do not form part of the stem-level domain, we might expect that genitive plural endings like *-ārum* and regular infinitives in *-āre*, *-ēre*, etc., in which the *r* is the product of rhotacism, would revert to being **-āsom* and **-āse* and so on, once the constraint ranking giving rise to rhotacism reached the stem level. The reason why it did not lies in the phonetic causes of the change of repair strategies which occurred when rhotacism made the transition from phrase level to word level. This change of repair strategies was caused, I claim, by a generation of learners perceiving their elders' intervocalic [z] as a token of one of two possible underliers: /s/ or /r/. This situation, and the response to it we expect the learner to display, is described in Tesar & Smolensky (1996: 41) and Kiparsky (2000a: 15): an output [A] that can reflect either /A/ or /B/ is parsed as /B/ when paradigmatic alternations make the underlying /B/ apparent, otherwise as /A/.

Therefore, because the [r] of the genitive plural and regular infinitive endings is always intervocalic, no alternation exists from which the learning generation can deduce that it reflects underlying /s/. This will cause them to parse the [r] as a token of /r/, by the principle of parsimony that Prince & Smolensky (1993) term lexicon optimisation. For *de-siliō*, by contrast, the alternation with the un-prefixed verb *saliō* suffices, at the word level, to make the underlying /s/ apparent, so that when the grammar reaches the stem level, the /s/ is no longer intervocalic, and is realised as [s].

The literature on the life cycle states that a generalisation makes the transition from stage 3 to stage L, becoming a systematic property of the lexicon, when its sensitivity to morpheme boundaries creates enough apparent counterexamples that its environment is no longer recoverable (Bermúdez-Otero 2011: §3). Ideally, we should like to be able to point to an identifiable change in the grammar that would give rise to such counterexamples in the case of rhotacism, and precipitate the transition from stage 3 to stage L. This would require a theoretical stipulation that allows VsV sequences to surface elsewhere than at morpheme

boundaries while rhotacism is still a part of the stem-level phonology.

This might be possible in the case of loanwords³ such as *basis* and *cisium* if we stipulate that, as loanwords, their morphological structure was not apparent and they therefore did not form stem-level domains. If such forms are possible, then stage 3 rhotacism becomes essentially a derived environment effect. This would, however, require a departure from our hypothesis that the stem-level input excludes the inflectional ending, since if we take the hypothesis as read, it is difficult to see how a loanword with regular inflection like *cisium* can be any less of a derived environment than any other inflected form.

I should prefer to say that the stage 3 state of affairs—in which both [s] and [r] appear on the surface and both /s/ and /r/ occur in underlying representations, but surface [r] is sometimes the exponent of underlying [s], is inherently unstable: as a phonological process becomes more sensitive to morphological structure, there will be more apparent exceptions to it on the surface, and it becomes more and more likely that learners will assume that the surface form always reflects the underlying representation unmodified. In this case, that involves a generation of learners treating every surface [r] as reflecting an underlying /r/, so that rhotacism becomes a property of the lexicon and the morphology rather than of the phonological component of the grammar.

2.4. Stage L — lexical listing

The extension of the *r* to the nominative in forms of the *honor*, *honoris* type is the latest exception to rhotacism, and I assign it to this, the latest stage in the life cycle. Some authors (Kenstowicz 1996; Benua 1997; Steriade 2000) have attempted to account for this overapplication of rhotacism within the constraint ranking, by means of Uniform Exponence or output-output correspondence constraints. The principal objection to this approach is that it would predict that the change from the *-os*, *-oris* pattern to the *-or*, *oris* pattern would be lexically abrupt, that is, that it would affect all the relevant nouns at the same time. This is not the case. In fact *honor*, the most commonly cited example, only begins to occur relatively late: Cicero, for example, uses *honos*, but *arbor* ‘tree’. In fact, the spread of the *-or*, *oris* pattern

³It is, however, not possible in the case of the degemination of *ss*; see note 6 below.

follows the standard progression of an analogy: it is phonetically abrupt, but lexically gradient (Bermúdez-Otero 2007: §21.3.1). Therefore, I argue that it is a matter of input restructuring, which is the Optimality-Theoretic mechanism by which analogy is modelled. Similar claims, with a computational model of the analogy in question, are advanced by Albright (2005).

Despite the levelling in polysyllabic nouns of the *-os*, *-oris* type, it must remain the case that the *os*, *oris* pattern remained a viable model on which to build a paradigm, since, in monosyllables such as *mos*, *moris* ‘custom’, and indeed *rus*, *ruris* ‘countryside’, we never find levelling: **mor* for ‘custom-NOM.SG’ is never attested, for example. Baldi (1994: 214) provides an example of this *-os*, *-oris* alternation being enforced where it is etymologically unexpected, in the form *iānitōs* ‘doorkeeper’ (the more common form *iānitor* reflects the original agent noun in *-tor*). The morphological productivity of the *-os*, *-oris* pattern in monosyllables can also be seen in the way paradigms are built for loans from Greek, such as *tūs*, *tūris* ‘incense’ (from Greek *t^húos*), and *glōs*, *glōris* ‘sister-in-law’ (from **/gloːs/* reanalyzed as */gloːs/*, or perhaps from Greek *gálōs*).⁴

3. CONCLUSION

In sum, I have proposed the following Stratal OT model of the progression of rhotacism through the life cycle:

STAGE 0 — PHONETIC TENDENCY. Co-articulatory pressures cause intervocalic voiceless consonants to tend to be realised as voiced.⁵

STAGE 1 — PHRASE-LEVEL PHONOLOGY. The phonetic tendency of stage 0 is phonologised as a pattern of non-neutralising intervocalic obstruent voicing, with the result that [z] becomes the regular allophone of /s/ between vowels.

STAGE 2 — WORD-LEVEL PHONOLOGY. The repair strategy by which intervocalic [s] is avoided changes: underlying /s/ is realised as [r] between vowels, unless this would create a sequence *rŕ*, which would violate the crucially undominated

⁴I am grateful to a reviewer for drawing these examples to my attention.

⁵As noted above (§2.1), this phonetic tendency is extremely general, and can be phonologised in many different ways: cf. Spanish *vida* from Late Latin *vita* ‘life’.

*[RHOTIC]- μ -[RHOTIC] constraint. Unless there are paradigmatic alternants with [s], subsequent generations interpret intervocalic [r] as a token of /r/, by lexicon optimisation.

STAGE 3 — STEM-LEVEL PHONOLOGY. Rhotacism is productive under the same conditions as at the word level, but only if the /s/ and the vowels around it are all contained within the phonological stem.

STAGE L — LEXICAL LISTING. Rhotacism is a systematic property of the lexicon, subject to extension by analogy. It is no longer productive over new VsV sequences, such as in loans or those created by the degemination of *ss*.

This model proposed demonstrates that by adopting Stratal OT, a formalism which includes observations of the life cycle of phonological processes in its basic architecture, we can construct an account of the diachronic development of rhotacism which explains all the apparent inconsistencies and exceptions to it listed in (1):

- (18) a. For the geminates, I argued that they are representationally equivalent to consonant clusters, and therefore not intervocalic in the sense penalised by INTER-V-VOICE. We know from ancient sources that the degemination in e.g. *causa* did not occur until after the time of Cicero (see Quintilian, *Institutio Oratoria* I, 7, 20–1), so rhotacism did not affect the new examples of intervocalic *s* because it was already at Stage L, and no longer a productive part of the phonology.⁶
- b. Similarly, the loanwords, such as *basis* and *cisium*, were borrowed at a stage when rhotacism was a property of the Latin lexicon, and not of the phonology.

⁶A reviewer suggests modelling the interaction between rhotacism and degemination as a synchronic chain shift, either by means of contrast-preservation constraints, or by positing a ranking giving rise to degemination at a later stage in the derivation than that which gives rise to rhotacism. This would be desirable insofar as it would provide a motivation for rhotacism to make the transition from stage 3 to stage L, as a generation of learners is confronted with a raft of forms with a new intervocalic [s], such as *causa*, *formosa* (from *caussa* and *formossa*), and so must assume that [r] always represents underlying /r/, no matter the consequences for the morphology. Unfortunately, however, considerations of relative chronology preclude it. As the extension of [r] to the nominative in nouns of the *honos* type was already underway at the time of Cicero (see §2.4), rhotacism must have entered stage L before then, and we know from Quintilian's witness that the degemination did not occur until after the time of Vergil. Therefore, at the time when degemination became a part of the phonology, rhotacism was already part of the lexicon: every surface [r] reflected underlying /r/

- c. The blindness of rhotacism to its intervocalic context, where a morpheme boundary intervenes, as in *de-siliō* and *nī-sī*, reflects the fact that at the most recent stage when rhotacism was part of the phonology, it was specifically part of the stem-level phonology, and therefore blind to phonological structure outside the stem-level domain. Examples of rhotacism in endings, such as *-ārum* and *-ere*, are relics of the word-level stage, preserved by lexicon optimisation.
- d. The dissimilatory blocking of rhotacism in forms like *miser* and *caesariēs* is regular, in obedience to a crucially undominated constraint penalising occurrences of *rŕ*. Apparent counterexamples, like *soror* and *uror*, are confined to final syllables, and the product of a sound change that took place after rhotacism had already entered stage L.
- e. Finally, the analogical extension of rhotacism to nominatives of the *honor* type is modelled as input restructuring, the spread of an idiosyncratic set of lexical exceptions that has its roots in what was formerly a productive phonological process.

Baldi (1994) closes his paper by claiming that ‘there is no synchronic rhotacism in Latin.’ Assuming that he intended to refer to the synchronic grammar of Classical Latin, I agree, but I would still prefer to conclude that there once was synchronic rhotacism in Latin, but there was less and less of it as time went on.

Centre for Linguistics and Philology

Walton Street

Oxford

OX1 2HG

Email: philip.roberts@ling-phil.ox.ac.uk

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